

Incoming goods inspection with AQL sampling: quality control without 100% inspection

Incoming goods inspection using an AQL sample is a standardised procedure in which, instead of complete delivery quantities, only a defined portion is inspected. Based on the Acceptable Quality Limits from DIN ISO 2859-1, a tested sample determines whether an entire acceptance quantity is accepted or rejected. For technical buyers, it is the central instrument for controlling quality in measurable terms without unnecessarily extending throughput time in the goods receipt area.

Key facts

- The AQL sample follows the standard DIN ISO 2859-1 and specifies how many units are to be inspected for a given lot size.
- AQL values are typically agreed between 0.065% and 4% depending on the criticality of the component.
- The inspection distinguishes three defect classes: critical, major and minor, each with its own limit values.
- Acceptance or rejection of the delivery is determined by the number and severity of the defects found in the sample.
- AQL certificates are the standard basis for claims in the returns process and for supplier evaluations.
- In cases of elevated risk, such as initial deliveries under a framework supply agreement or delivery bottlenecks, tightened inspection plans are used.

Definition: incoming goods inspection with AQL sampling

Incoming goods inspection using the AQL sample (Acceptable Quality Limit) is a standardised procedure for lot-by-lot quality control in which a mathematically defined sample is drawn from a delivery quantity. If the number of defects is below the agreed limit, the lot is accepted. If it exceeds the limit, the lot is rejected, reworked or blocked.

Basic principle of sample selection

Ideally, the sample is taken at random from the entire lot, not deliberately from one layer or pallet. The sample size depends crucially on the lot size and the agreed inspection level; General Inspection Level II is frequently used. The larger the lot, the larger the sample, but inspection costs rise less than proportionally.

- Statistically significant statement about the entire lot with reduced inspection effort
- Random selection instead of targeted picking to avoid bias
- Inspection Levels I to III for adapting to criticality and supplier risk

AQL value and defect classes

The AQL value defines the maximum proportion of defective units in percent that is still acceptable as a process upper limit. A distinction is customary between critical defects (AQL 0% or 0.065%), major defects (frequently AQL 1.0–2.5%) and minor defects (frequently AQL 2.5–4%). For safety-relevant components, significantly stricter AQL requirements are agreed than for standard components.

Methods and procedure of AQL-based incoming goods inspection

In practice, the AQL inspection passes through defined steps, from its provision in the purchase order to further processing in the system. The basis is a prescribed inspection instruction with defined characteristics, prepared inspection tools and documented evaluation steps.

Agreement in the framework supply contract

For the sample to stand up legally, AQL values, defect classes, inspection levels and response routes must be anchored in the framework supply agreement or in a quality assurance agreement. If such provision is missing, there is a risk in the event of a dispute that the rejection of a lot cannot be enforced in court. Typical clauses additionally govern the sharing of costs in the event of rejection and the inspector's documentation obligation.

Procedure of the inspection at goods receipt

After posting the goods receipt, the lot is registered via the order release and the accompanying inspection document. The inspector draws the defined number of units, evaluates each part against the inspection characteristics list and documents the defects. The decision is accept, accept with conditions or reject – depending on the number of critical, major and minor defects found.

- Determine lot size and draw the sample according to the tables
- Inspect characteristics (visual inspection, dimensional inspection, functional test depending on the inspection instruction)
- Classify defect types and compare them with the AQL limit values of the inspection class
- Document the decision and notify planning/dispatch, quality and procurement

Normal, tightened and reduced inspection

ISO 2859-1 provides for three inspection states. With good supplier quality, one switches permanently to reduced inspection in order to lower inspection costs. With systematic defect patterns, inspection is tightened, i.e. the same lot size but inspected units with stricter limit values.

Key KPIs of AQL incoming goods inspection

The AQL inspection generates a wealth of quality data that delivers genuine supply chain value beyond the mere lot decision. The key performance indicators help to evaluate suppliers monthly and to control tightened inspection steps on a data-driven basis.

Supplier evaluation via defect rates

Central to this is the measured defect rate per supplier and part class. It is calculated from the sum of the defects found in relation to the number of units inspected. If the agreed AQL is repeatedly exceeded, the supplier should provide an 8D report for root cause correction.

Inspection costs and throughput time at goods receipt

The trade-off must be borne in mind: a tighter AQL slows throughput time and increases inspection costs per lot. Data such as average inspection time per line item or the proportion of blocked lots helps to align inspection effort with actual supplier quality. Inventory analysis also benefits: anyone holding expensive blocked lot stock in the bonded warehouse is better able to identify the financial damage of non-availability.

Data basis for pre-qualification and spend analytics

The AQL history feeds into the pre-qualification of new suppliers and into the evaluation segments of the supplier base. When quality data is linked with spend analytics, the damage per supplier is expressed in euros rather than percent. This is usually the stronger argumentative basis for supplier development or bundling levers.

Key KPIs and definitions of the AQL inspection

The AQL inspection generates quantitative key figures that deliver genuine added value beyond the lot decision alone. They help to evaluate suppliers systematically and to adjust inspection effort or inspection stringency on a data-driven basis.

Supplier evaluation via defect rates

Central to this is the measured defect rate per supplier and part class, calculated from the number of defects in relation to the inspected sample. Repeated exceedance of the agreed AQL value is the trigger for an 8D report from the supplier. The supplier's Data Quality Score evaluation also incorporates the AQL results as an objective component.

Inspection costs and throughput time

A stricter AQL slows throughput time at goods receipt and increases inspection and storage costs for blocked lots. KPIs such as average inspection time per line item, proportion of rejected lots and capital tied up in blocked stock help to align inspection effort with the actual defect history.

Data basis for pre-qualification and assortment strategy

The AQL history feeds into the pre-qualification of new suppliers and into the ongoing evaluation of the supplier base. Linking sample results with spend analytics makes the damage per supplier visible in euros – a significantly stronger argument for supplier negotiations or bundling levers than mere percentage figures.

Risks and controls relating to the AQL sample

Sampling is a statistical instrument with a deliberate residual risk: defects below the sampling limit reach production with a certain probability. Those who are aware of this can safeguard themselves through inspection planning, contract clauses and additional controls.

Statistical residual risk and critical components

No AQL level provides complete protection against defective units in the accepted lot. For safety-critical or expensive components, for example in medical technology or aerospace, 100% inspection or an extended inspection level is therefore customary. The transition should be risk-based rather than applied across the board.

Contractual and regulatory controls

Anyone relying on AQL results for complaints must have the provisions documented and the inspection staff trained. Certifications such as IATF 16949 or ISO 13485 require defined inspection instructions, traceability and calibration of measuring equipment. AQL certificates should also be handed over when a framework supply agreement or amendment expires.

Supplier response and complaint process

For rejected lots, the returns process is the lever for controlling costs and delivery tracking of replacement deliveries. A structured 8D report from the supplier clarifies cause, correction and preventive action. Without documented corrective change at the supplier, repeated defect sources and rising scrap costs in one's own process loom.

Current developments: digitalisation and data-driven inspection stringency

Traditional AQL inspection remains valid, but its administration is increasingly being digitised. Advances in measuring systems, cloud platforms and AI-based defect detection are shifting the boundary between sampling and continuous in-line quality control.

Digital inspection documentation and Data Quality Score

Modern goods receipt systems digitise inspection records, integrate cameras, measuring equipment and ERP evaluations, and make the AQL inspection independently evaluable. A holistic Data Quality Score for suppliers consolidates inspection history, delivery reliability and complaint rates into a single figure. This significantly facilitates data-driven sourcing decisions.

Risk-based inspection stringency instead of a blanket AQL

Instead of a single company-wide AQL for all components, more and more companies are using risk heatmap-based inspection stringency. Critical components are inspected more strictly, while industrial parts with historically stable delivery quality benefit from reduced inspection plans. This lowers costs and throughput time without risking quality.

Automated visual inspection and AI

Visual AI systems now detect surface defects in practice frequently more reliably than manual visual inspection and operate without fatigue effects. They do not fully replace the AQL concept, but shift it: instead of planning personnel capacity, the focus is on maintenance and recalibration of the camera systems.

Typical metrics

Defect rate per supplier: < 1%

Based on units inspected at goods receipt; benchmark for established series suppliers

AQL major defects: 1.0–2.5%

Frequently agreed range for standard components according to DIN ISO 2859-1

Proportion of rejected lots: < 2%

KPI for the stability of delivery quality; higher values indicate a need for tightened inspection

Average inspection time per line item: 5–20 minutes

Typical benchmark per purchase order line, depending on complexity and inspection effort

Practical example

A medium-sized mechanical engineering company procures cast housing parts under a long-standing framework supply agreement with AQL 1.0 for major defects. After several elevated defect rates at goods receipt, the company raises the inspection level to Level III and demands an 8D report from the supplier. In parallel, the supplier's Data Quality Score is downgraded and the risk assessment in the product health matrix is revised.

- Tightened AQL inspection plan for the critical part class
- Supplier evaluation based on defect rate and 8D documentation
- Returns process with allocation of the costs payable per rejected lot

Conclusion

The AQL sample is a mature, statistically grounded procedure that makes incoming goods inspections feasible and affordable in practice. The prerequisite is that AQL values, defect classes and response processes are contractually binding and that results are consistently documented and evaluated.

Anyone who integrates the key figures into supplier evaluation, spend analytics and the risk heatmap turns the inspection into a data-driven control instrument. This reduces inspection costs without risking delivery quality.

Frequently asked questions

What does AQL mean in incoming goods inspection?

AQL stands for Acceptable Quality Limit and denotes the maximum tolerated defect rate in a lot that is still considered acceptable. In incoming goods inspection, a defined sample is taken from a lot and the number of defects is compared with the agreed AQL. If the count is below the limit, the lot is accepted; otherwise it is rejected or reworked.

How is the sample size calculated for AQL?

The sample size is based on the lot size and the selected inspection level in accordance with DIN ISO 2859-1. In practice, General Inspection Level II is frequently used; the tables of the standard then specify the sample size and the associated acceptance and rejection numbers. For standard parts, the sample typically ranges from 8 to 200 units per lot.

Which AQL values are common in industry?

Typical values are 0% to 0.065% for critical defects, 1.0% to 2.5% for major defects and 2.5% to 4% for minor defects. For safety-relevant or high-quality components, stricter AQL values of 0.065% to 0.4% are agreed. The specific value depends on criticality, the supplier's process maturity and the cost of a failure consequence in one's own production.

Must every incoming goods inspection be performed using AQL?

No, the AQL sample is one instrument among several. For safety-critical parts, initial deliveries or previously reorganized suppliers, 100% inspection or tightened inspection is more sensible. For very simple parts with historically stable delivery quality, inspection can also be dispensed with altogether, or

the delivery seal may be used as proof of inspection, provided this is contractually defined.

What happens if a lot is rejected after the AQL inspection?

The lot is blocked and not withdrawn into production. Typical responses are rework by the supplier, return via the returns process, a special arrangement with a price reduction, or complete scrapping. In parallel, root cause analysis should be carried out via an 8D report to avoid repeat defects at the next delivery date.

When is tightened inspection used with AQL?

Tightened inspection is activated when several consecutive lots have only narrowly met the acceptance limit or when defect groups have become conspicuous, for example after changes in the supplier's manufacturing process. Tightened inspection is also customary for an initial delivery by a re-qualified supplier. The aim is to increase the probability of detecting poor-quality lots before they reach production.